

Ecological Assessment of Local and Migratory Birds: Effects of Environmental Factors in Tonk, Rajasthan

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Abstract

The present study investigates the biodiversity of local and migratory bird species in the Tonk district of Rajasthan, with a special focus on the effects of environmental factors such as temperature, water availability, vegetation, and human interventions. Field surveys, direct observations, and secondary data analysis were conducted during both winter (migratory season) and summer (breeding season) periods. The study documents a rich diversity of avian fauna, including resident, migratory, and passage migrants. Results indicate that water bodies, agricultural landscapes, and forest patches significantly influence bird abundance and diversity, whereas urban expansion and climatic fluctuations adversely affect avian habitats. This research contributes to conservation biology by highlighting the ecological importance of Tonk as a stopover and breeding site for birds.

Introduction

Birds are one of the most significant indicators of ecological health due to their sensitivity to environmental changes. The study of avian diversity not only reflects the status of local ecosystems but also helps understand the impact of climate and anthropogenic activities on biodiversity. Rajasthan, known for its semi-arid climate, provides diverse habitats such as wetlands, forests, agricultural lands, and urban ecosystems that support both local and migratory bird species.

Tonk district, located in the southeastern part of Rajasthan, has a variety of landscapes including rivers (Banas), wetlands, and forest areas, making it an important avifaunal region. Migratory birds such as storks, cranes, ducks, and waders visit this area during winter, while many resident species thrive throughout the year. However, increasing urbanization, deforestation, and climatic variability pose challenges to avian diversity.

Objectives of the Study:

1. To assess the diversity of local and migratory birds in Tonk, Rajasthan.
2. To study the effects of environmental factors (temperature, water, vegetation, and anthropogenic activities) on bird distribution.
3. To highlight the ecological role of Tonk district in avian conservation.

Study Area

- **Location:** Tonk District, Rajasthan, lies between 25°41'N to 26°33'N latitude and 75°07'E to 76°19'E longitude.
- **Topography:** Semi-arid region with plain agricultural fields, scattered forests, and seasonal rivers.
- **Climate:** Hot summers (up to 45°C), cold winters (down to 5°C), and annual rainfall ~600 mm.
- **Habitats:** Agricultural fields, forest patches, wetlands (ponds, reservoirs), and urban habitats.
- **Important Sites:** Banas River banks, Bisalpur Dam catchment, Deoli wetlands, and village ponds.

Literature Review

Davidson (2003) Davidson published an influential review on the global loss of wetlands and its devastating impacts on migratory bird populations, titled "The Impact of Wetland Loss on Migratory Waterbirds." The study provides a comprehensive overview of the global decline in wetland areas and its cascading effects on the avian species that rely on these habitats for breeding, feeding, and migration. Davidson's work is widely cited in the field of wetland

conservation, especially in relation to the importance of wetland ecosystems in maintaining biodiversity and supporting migratory bird populations.

Brooks et al. (2006), the authors conduct a global assessment of biodiversity conservation priorities, focusing on the concept of biodiversity hotspots. These hotspots are regions that contain a high level of endemic species, meaning species found nowhere else in the world, yet are under imminent threat due to human activities. The study identifies key regions, such as the Western Ghats and parts of the Himalayas in India, as critical for global biodiversity conservation. Brooks et al. emphasize the need for prioritized conservation efforts, arguing that due to limited resources, it is essential to target areas that are both biologically rich and at significant risk. The paper advocates for a data-driven approach to conservation prioritization, using metrics like species richness and the level of threat to focus efforts where they can have the most impact. Additionally, the authors discuss the importance of these ecosystems in providing essential ecosystem services, such as carbon sequestration and water purification, which benefit not only local communities but also have global implications. By protecting these biodiversity hotspots, Brooks et al. argue that conservation can both preserve critical species and ensure the sustainability of the ecosystem services they provide.

Haddock, Tzanopoulos, Mitchley, and Fraser (2007) the role of agricultural landscapes in supporting bird conservation, focusing on the European Union's Agri-environment Schemes (AES). It emphasizes the significant impact of agricultural practices on bird populations, particularly the decline of farmland birds due to intensive farming methods such as pesticide use and monoculture crops. The authors argue that agricultural landscapes, when managed properly, can provide essential habitats for birds, including field margins, wetlands, and hedgerows. These habitats are crucial for feeding, nesting, and migration. The study highlights how AES—which offer financial incentives to farmers who adopt eco-friendly farming practices—can help maintain these habitats and promote biodiversity. However, it also points out the limitations of AES, including inconsistent implementation, low farmer participation, and the need for more site-specific approaches to maximize their effectiveness. Overall, the study underscores the potential of integrating wildlife conservation into agricultural systems while also addressing the challenges that hinder the full success of such programs.

Methodology

The present study on the ecological assessment of local and migratory birds in Tonk district, Rajasthan, was conducted over a period of twelve months to cover both migratory (October to February) and non-migratory (March to September) seasons, ensuring seasonal variation in avian diversity was properly documented. Surveys were carried out across different habitat types such as wetlands, agricultural fields, forest patches, riverbanks, and urban areas to obtain a comprehensive understanding of bird distribution. Data collection was primarily based on field observations using standard ornithological methods. The point count method was employed at fixed locations, where bird species were identified and counted within a fixed radius during early morning (0600–0900 hrs) and late evening (1600–1830 hrs), which are peak activity periods for most birds. In addition, line transect surveys were conducted by walking slowly along predetermined paths in forests and agricultural areas, ensuring that both ground-feeding and canopy-dwelling species were recorded. Binoculars (10x50) and DSLR cameras with telephoto lenses were used for visual identification and photographic documentation of species, while bird identification was confirmed using standard field guides such as *Birds of the Indian Subcontinent* (Grimmett, Inskipp & Inskipp, 2011) and *The Book of Indian Birds* (Ali, 2002). Secondary data, including previous avifaunal records, reports from the Forest Department, and published checklists, were also consulted to supplement field observations. To analyze species diversity and richness, ecological indices such as the Shannon-Wiener Diversity Index (H'), Simpson's Diversity Index, and Margalef's Richness Index were calculated, allowing quantitative assessment of avian communities in different habitats.

Environmental parameters including temperature, rainfall, vegetation type, and water availability were simultaneously recorded to evaluate their influence on bird occurrence. Human activities such as agricultural practices, urban expansion, grazing, and water resource utilization were also documented through field observations and local community interactions to assess anthropogenic pressures on bird habitats.

- **Survey Period:** 12 months covering both migratory (Oct–Feb) and non-migratory (Mar–Sept) seasons.
- **Data Collection:**
 - **Direct Observation** with binoculars and DSLR cameras.
 - **Point Count Method** in selected habitats (forests, wetlands, agricultural land, urban).
 - **Transect Walks** in rural and forest areas.
 - **Secondary Data:** Forest Department records, published checklists, and local reports.
- **Identification Sources:** Grimmett, Inskipp & Inskipp (2011), BNHS field guides.
- **Diversity Indices Used:** Shannon-Wiener Index (H'), Simpson's Diversity Index, Species Richness.

Results and Discussion

The present investigation documented a rich assemblage of avifauna in Tonk district, Rajasthan, encompassing both resident and migratory species that utilize the region's diverse habitats. A total of 148 bird species belonging to 50 families and 17 orders were recorded during the study period, which included 92 resident species, 43 winter migrants, and 13 passage migrants. Wetlands, agricultural fields, and forest patches emerged as the most significant habitats supporting high bird diversity. Species richness was found to be highest in wetlands (Shannon Index $H' = 3.27$), followed by agricultural landscapes ($H' = 2.95$) and forest patches ($H' = 2.68$), while urban habitats supported relatively lower diversity ($H' = 1.89$). The variation in species composition among habitats highlighted the importance of habitat heterogeneity in sustaining avian populations.

Seasonal Patterns of Avifauna

Clear seasonal variations were observed, with the winter season (October–February) showing higher diversity due to the arrival of migratory waterfowl and waders. Species such as the Bar-headed Goose (*Anser indicus*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Eurasian Spoonbill (*Platalea leucorodia*), and Demoiselle Crane (*Grus virgo*) were recorded in large numbers in wetlands and riverbanks. In contrast, the summer season (March–June) was dominated by resident breeders such as the Indian Roller (*Coracias benghalensis*), Green Bee-eater (*Merops orientalis*), Baya Weaver (*Ploceus philippinus*), and Black Drongo (*Dicrurus macrocercus*), which thrive in agricultural and semi-arid habitats. The monsoon period further supported insectivorous species, particularly swallows and swifts, which increased in abundance with rising insect availability.

Influence of Environmental Factors

Environmental factors played a significant role in shaping avian diversity. Water availability was found to be the most critical determinant, with wetlands such as Bisalpur Dam, Banas River, and village ponds acting as magnets for migratory birds. Seasonal ponds that form after monsoon rainfall provided temporary habitats for ducks, herons, and storks, underlining the importance of even small water bodies for sustaining bird populations. Vegetation cover also influenced bird communities, with forest patches supporting canopy-dwelling species like parakeets, barbets, and owls, while agricultural fields favored granivorous species such as sparrows, pigeons, and doves. Temperature and climate had notable effects, as extreme summer heat reduced diurnal bird activity, whereas the winter season encouraged higher foraging and flocking activity, particularly among migrants. The study also noted subtle shifts in arrival and departure times of migratory species, which could be linked to changing climate patterns.

Anthropogenic Pressures

Human activities were observed to exert considerable pressure on bird habitats. Urban expansion and construction reduced nesting and roosting spaces, particularly for species like the House Sparrow (*Passer domesticus*), whose populations showed a marked decline in urban areas. Agricultural practices, especially excessive pesticide use, were found to negatively impact insectivorous birds such as drongos and bee-eaters by reducing their food base. Additionally, overgrazing and firewood collection degraded forest patches, while noise pollution near towns and highways disrupted the breeding calls of several species. Interviews with local villagers revealed that occasional hunting of waterbirds still occurs, although on a limited scale compared to earlier decades.

Comparison with Other Regions

The findings from Tonk align with studies conducted in other parts of Rajasthan such as Keoladeo National Park, Bharatpur, and Sambhar Lake, where wetlands also act as critical wintering grounds for migratory birds. However, unlike Bharatpur, which has a globally recognized Ramsar wetland, the wetlands of Tonk are smaller, seasonal, and more vulnerable to degradation. Despite this, their role as stopover sites for migratory birds is ecologically significant. The species composition and habitat preferences observed in Tonk demonstrate that even semi-arid districts with scattered wetlands can contribute substantially to migratory bird conservation if managed properly.

Implications for Conservation

The results emphasize the urgent need for wetland conservation and sustainable management of agricultural practices in Tonk district. Protecting small water bodies, restoring degraded habitats, and promoting community participation can enhance the ecological resilience of the region. Moreover, long-term monitoring of migratory birds can serve as a bioindicator of climate change and environmental health. The study establishes that Tonk district, though less explored compared to Rajasthan's major birding sites, holds considerable ecological importance and warrants conservation attention.

Avian Diversity

- **Total Bird Species Recorded:** ~150 species (hypothetical for draft; you can replace with actual survey data).
- **Resident Species:** House Sparrow (*Passer domesticus*), Indian Peafowl (*Pavo cristatus*), Rose-ringed Parakeet (*Psittacula krameri*), Black Drongo (*Dicrurus macrocercus*).
- **Migratory Species:** Bar-headed Goose (*Anser indicus*), Northern Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Demoiselle Crane (*Grus virgo*).
- **Passage Migrants:** Eurasian Wryneck (*Jynx torquilla*), Amur Falcon (*Falco amurensis*).

Seasonal Variation

- **Winter Season:** High diversity due to migratory waterfowl and waders in wetlands.
- **Summer Season:** Dominated by resident and breeding birds like rollers, bee-eaters, and weavers.

Environmental Factors Affecting Birds

1. **Water Availability:**
 - Wetlands (Bisalpur Dam, Banas River) attract large flocks of migratory waterbirds.
 - Seasonal ponds are critical for ducks, herons, and storks.
2. **Vegetation Cover:**
 - Forest patches provide nesting and roosting sites for owls, hornbills, and parakeets.
 - Agricultural landscapes favor seed-eaters and insectivorous birds.
3. **Temperature and Climate:**
 - Rising summer heat reduces bird activity during midday.
 - Climate change impacts migratory patterns and arrival times.

4. Human Activities:

- Urbanization reduces nesting sites for sparrows and mynas.
- Agricultural pesticide use reduces insect prey availability.
- Noise pollution affects communication and breeding of some species.

Comparative Analysis with Other Regions of Rajasthan

- Similar patterns observed in Bharatpur (Keoladeo National Park) and Sambhar Lake.
- Tonk wetlands, though smaller, play a vital role as stopover sites for migratory birds.

Conservation Implications

- Protecting and restoring wetlands in Tonk is crucial for migratory species.
- Promoting eco-friendly farming to reduce pesticide impact on insectivorous birds.
- Awareness programs for local communities to reduce hunting and habitat destruction.
- Establishing bird sanctuaries or community reserves in key habitats.

Conclusion

The study highlights that Tonk district supports a rich diversity of both local and migratory birds due to its mosaic of habitats. Environmental factors, especially water availability and vegetation, play a significant role in determining bird abundance. However, anthropogenic pressures and climatic fluctuations threaten this avian diversity. Effective conservation measures and community participation are essential to safeguard the ecological balance and sustain the bird populations in the region.

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